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Joint Strike Fighter (JSF): Potential National Security Questions Pertaining to a Single Production Line

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Christopher Bolkcom and Daniel Else
Analysts in National Defense
Foreign Affairs, Defense, and Trade Division

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Summary

The Joint Strike Fighter (JSF) program is intended to develop and build a family of new-generation tactical combat aircraft for the U.S. Air Force, the Marine Corps, the Navy, and Britain's Royal Navy. As now projected, the JSF will become the U.S. Defense Department's (DoD) largest ever acquisition program in terms of future cost and number of aircraft to be produced.

A controversial aspect of the JSF program has been the "winner-take-all" approach that DoD used to award the development and demonstration contract. On October 26, 2001, senior DoD officials announced that a team led by Lockheed Martin (and composed of Northrop Grumman, and BAE Systems) had beaten a team led by the Boeing Company, winning the exclusive rights to enter the JSF program's system development and demonstration (SDD) phase, and to build all 2,912 JSF aircraft. Some observers contend that DoD's "winner-take-all" approach to JSF production could have negative implications for the defense industrial base and U.S. national security.

In official communications, DoD has consistently maintained that the winner-take-all approach is the best vehicle for acquiring the JSF because it is the most cost effective strategy, and that any defense industrial base concerns can be dealt with as they arise. Aerospace industry officials have also publically expressed their support for the winner-take-all strategy. Congressional support for the approach appears mixed, and legislation has been enacted mandating a detailed study of the potential industrial base implications.

It appears that a substantial amount of analysis has focused on the cost implications of the winner-take-all strategy versus splitting the JSF contract between two or more producers. However, it also appears that to date, much less analysis has focused on the potential defense industrial base consequences.

When considering the potential national security implications of a single manufacturer of the JSF, the following questions of potential interest to Congress arise: 1) Will awarding production of the JSF to a "single manufacturer" degrade the future U.S. defense industrial base's ability to generate competition in the design of short range manned combat aircraft, such as the JSF in the post JSF time frame? 2) Will there be a demand for short range manned combat aircraft in the post-JSF environment?

Observers tend to agree that maintaining combat aircraft design capabilities is more critical and more difficult than maintaining production capabilities. Yet, there is disagreement about whether design capabilities can be maintained in the absence of continued work. Also, many argue that other platforms, such as unmanned aerial vehicles, could supplant manned combat aircraft in the post-JSF future. Other observers disagree, and argue that it is likely that DoD will require a manned combat aircraft after JSF, if only for niche missions.

Contents

List of Tables

Joint Strike Fighter: Potential National Security Questions Pertaining to a Single Production Line

Background

Joint Strike Fighter (JSF) Program[1]

The Joint Strike Fighter (JSF) program is expected to develop and build a family of new-generation tactical combat aircraft for the U.S. Air Force, the Marine Corps, the Navy, and Britain's Royal Navy. As now projected, the JSF will become the U.S. Defense Department's (DoD) largest acquisition program in terms of future cost and number of aircraft to be produced.

Current plans call for production of 2,912 aircraft in three different versions -- 1,763 conventional take off and landing variants for the Air Force, 609 vertical/short take off and landing versions for the Marine Corps, up to 480 carrier-capable versions (called CV) for the Navy and 60 for the British Navy. Additional aircraft may be bought by Australia, Belgium, Canada, Denmark, the Netherlands, Norway and other allied governments.

The JSF program is scheduled to begin production around 2005, with first aircraft deliveries projected to start in 2008. For years, the JSF's cost goal was an average flyaway cost of $28-$38 million in FY1994 dollars, depending on the service version. In November 2000, the program director revised that goal to $31-$38 million each. The total program acquisition cost of the JSF program has been estimated by CBO at about $219 billion in FY1997 dollars, including some $22 billion for research and development (R&D) and some $197 billion to procure these aircraft.[2] Their actual costs will depend on future inflation rates, technological factors, and procurement schedules.

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[1]For a comprehensive treatment of the Joint Strike Fighter program, see CRS Report RL30563, *Joint Strike Fighter (JSF) Program: Background, Status, and Issues* by Christopher Bolkcom.

[2]Lane Pierrot and Jo Ann Vines, *A Look at Tomorrow's Tactical Air Forces*, Washington: U.S. Congressional Budget Office, January 1997, pp. 83-87. This estimate assumed a JSF program of 2,978 aircraft (including 60 U.K. JSFs) as then projected. In May 1997, the Quadrennial Defense Review recommended 2,852 U.S. JSFs, which together with 60 U.K. JSFs would be a 2,912-plane program. Procuring fewer planes increases the unit cost of each plane but reduces the total procurement cost of the program.

The Department of Defense has declared the JSF to be the last manned tactical fighter that it intends to procure during at least the next several decades. The Department awarded the development contract (along with the expectation of follow on production) to a team of manufacturing companies headed by a single prime contractor, Lockheed Martin.

This "winner-take-all" award brings into sharp focus several significant issues with respect to the industrial base that designs, develops, manufactures, and sustains high performance military aircraft. During the 1990s, the number of companies in the U.S. aerospace industry capable of acting as prime contractors has fallen precipitously due to a series of corporate mergers, acquisitions, divestitures, and consolidations. While there appears to be a general consensus among analysts that sufficient aircraft production capabilities will continue to exist, the consolidation has led some to question the industry's ability to continue competing for major aircraft contracts.[3]

The debate appears to center on the extent that corporate competition encourages cost reduction and aircraft design innovation. Some observers take the position that at least two competing corporate teams are necessary to spur needed efficiency and inventiveness. Others claim that mechanisms other than competition can serve to curb cost rises and that design innovation is possible without competing teams of expensive, highly specialized teams of design engineers.

JSF Acquisition Controversy

One of the more controversial aspects of the JSF program has been the "winner-take-all" approach that DoD used to award the development and demonstration contract. On October 26, 2001, senior DoD officials announced that a team led by Lockheed Martin (and composed of Northrop Grumman, and BAE Systems) had beaten a team led by the Boeing Company, winning the exclusive rights to enter the JSF program's system development and demonstration (SDD) phase, and to build all 2,912 JSF aircraft.

This decision was part of a larger acquisition process where DoD had steadily winnowed down the competitors in three stages from three companies, to two, to one. In the first phase, Lockheed Martin, Boeing, and McDonnell Douglas competed for the JSF's concept demonstration phase contract. McDonnell Douglas lost this competition, and subsequently was acquired by Boeing. During concept demonstration, Lockheed Martin and Boeing built and flight tested prototype aircraft, as they competed for the SDD contract.

Some observers contend that DoD's "winner-take-all" approach to JSF production could have negative implications for the defense industrial base and U.S. national security. They make the following argument: over the last 40 years, the U.S. demand for fighter aircraft has steadily declined, and after the JSF program, will likely continue to decline. This reduction in business has helped fuel a major consolidation in the aerospace industrial base, leaving only a few companies capable of designing

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[3]Appendix I gives the historical background on consolidation of and competition within the U.S. defense industrial base.

and manufacturing combat aircraft. If the JSF production contract is awarded to a single company, it is likely that its competitors will not be able to sustain their combat aircraft design and manufacturing capabilities due to a lack of business.[4] Opponents of the winner-take-all approach argue that DoD should award JSF production to at least two companies, which should ensure at least two companies remain capable of manufacturing combat aircraft, and thus benefit the defense industrial base by maintaining competition in future years.

DoD Perspective. The Department of Defense has been the main proponent of the winner-take-all approach. In a September 2001 letter to the Senate Armed Services Committee, Undersecretary of Defense Edward "Pete" Aldridge reaffirmed DoD's commitment to the winner-take-all strategy. He wrote that DoD had reviewed the pros and cons of an alternative strategy that would keep "both contractors involved in meaningful work" and "would also permit both contractors to compete for the production of future variants of the JSF configuration."[5] Secretary Aldridge wrote that DoD had decided against the alternative strategy because:

1. The teams were formed, commitments made, and the competition conducted under a winner-take-all approach. it would be unfair to the winner to force him to restructure his team to accept the "loser."
2. We would introduce significant delay (6-9 months) in the current plan if we asked the competitors to revise their proposals to reflect this new arrangement.
3. The program cost would increase to accommodate the overhead of another team member who must retain a duplicate level of expertise to be prepared for a future competition. This could be a cost of $500 million to $1 billion impact on program costs.
4. There will be sufficient work on UAVs, UCAVs, a new Long-Range Strike Aircraft, and Foreign Military Sales of F/A-18E/F (Boeing) and F-22 (Lockheed Martin) to retain some tactical aircraft design team expertise after the JSF competition and the planned F-22 and F/A-18E/F production.
5. If there were a decline in the currently planned force structure, the potential cost savings for future JSF production competitions would be less than might be predicted now.
6. Finally, it is not clear that there will be a competition of a manned tactical aircraft after the JSF in the 2020-2025 period.[6]

DoD has conducted a number of internal and external studies on the JSF winner-take-all strategy. Two internal studies showed that splitting production between two contractors would increase initial costs between $900 million and $1.4 billion.[7]

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[4]DoD currently plans to end production of the F-22 Raptor and the F/A-18E/F Super Hornet in 2013. If this plan holds, in 2013 the JSF will be the only combat aircraft in production.

[5]Edward "Pete" Aldridge, Undersecretary of Defense for Acquisition, Technology and Logistics, letter to The Honorable Carl Levin, Chairman, Senate Committee on Armed Services. September 25, 2001.

[6]*Ibid*.

[7] Greg Jaffe, "Pentagon Cost Study Led to Plan for Fighter Plane," *Wall Street Journal*, June

(continued...)

In July 1999, a Defense Science Board task force on acquisition reform recommended that two companies build the same JSF design. The companies would compete for each lot of aircraft production. This would ensure price competition and innovation as each company attempts to win a larger share of JSF production.[8] This strategy has been used by DoD to produce other weapons, such as AMRAAM and Tomahawk missiles. However, in a June 22, 2000 news conference, Undersecretary of Defense Jacques Gansler downplayed the DSB recommendation, saying that the DSB had not conducted "a quantitative, detailed analysis." Gansler said that competitive production had been "very successful on missiles, very successful on jet engines," but "it's never been done on airplanes."[9]

DoD asked the RAND Corporation to conduct an independent analysis of the JSF acquisition strategy. This report, *Assessing Competitive Strategies for the Joint Strike fighter: Opportunities and Options* was released in April 2001, and endorsed the winner-take-all approach. RAND analysts found it unlikely that DoD would recoup costs through establishing a second production line, and suggested that the best way to keep costs down would be to give production to one team, and compete future upgrades to the aircraft.[10] Regarding the industrial base, the RAND report determined that "no one has persuasively argued that a winner-take-all strategy in the JSF would inexorably lead to the loser exiting the fighter aircraft business, or even that the loser would clearly lose an important degree of capability to continue as a competitive supplier or combat aircraft systems in the future."[11] In DoD, it appears that this subsequent analysis has outweighed the DSB recommendation on split production.

Industry Perspective. It appears that industry leaders have consistently voiced their support of the JSF winner-take-all strategy on cost saving grounds. In March 2000, executives from Boeing and Lockheed Martin reportedly urged a Pentagon advisory panel not to alter the winner-take-all strategy.[12] This position was reinforced a month later when Boeing company executives expressed their opposition to a proposal that the JSF be manufactured by two different companies. Boeing Vice President Frank Statkus was reported to have argued that two different production lines would not reduce costs, "If our configuration is selected, there is no value in

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[7](...continued)
28, 2000.

[8]Robert Wall, "Multiple JSF Builders Urged," *Aviation Week & Space Technology*, September 13, 1999, p.33.

[9]Kenneth H. Bacon, Assistant Secretary of Defense (Public Affairs) and Dr. Jacques Gansler Under Secretary of Defense for Acquisition, Technology and Logistics, News Briefing, June 22, 2001, 1:30 p.m. EST.

[10]Adam Hebert, "RAND: Funding Alternate JSF Avionics Teams Would Likely Benefit DoD," *Inside the Air Force*, April 6, 2001.

[11] *Ibid.*

[12]Anne Marie Squeo, "Lockheed Martin and Boeing Urge Panel for Sole Winner," *Wall Street Journal*, March 15, 2000.

having separate lines....Having two complete assembly lines is a big concern."[13] Lockheed Martin also stressed that their approach to producing the JSF would preclude the need for two lines. Frank Cappuccio, Lockheed Martin's JSF program manager, claimed that Lockheed Martin's team approach would create a competitive production environment. "If the challenge is to sustain production competition through the life of the program...we can do that internal to the team," he said.[14]

Industry's perspective on the industrial base implications of the winner-take-all strategy appears less consistent than its stand on cost savings. On the one hand, company executives have downplayed the impact of winner-take-all on the industrial base. Lockheed Martin executive vice president Tom Burbage, for example, was quoted as saying that the U.S. industrial base would not necessarily decline. Burbage said that there was other work that could sustain his company if they lost the JSF program. "There's a perception that if you do a winner-take-all that half of the U.S. industrial base turns their lights out as a result—that's not exactly what happens."he said.[15]

On the other hand, all companies involved in the JSF competition have stressed the great importance of that contract to their financial well being. Lockheed Martin executives have pinned their future on the award of the JSF. "This contract is as vital for our fighter operations as it is for theirs (Boeing's)."[16] Northrop Grumman, a member of the Lockheed Martin JSF team, has also weighed in on the industrial base issue. Company officials informed DoD that they would require at least 20 percent of the JSF production business if they are to remain a potential prime contractor for military aircraft. While Northrop Grumman is not the lead contractor on any military aircraft programs presently in production, it does build 40 percent of Boeing's F/A-18E/F, is a major subcontractor on Boeing's C-17, and provides radars for Lockheed Martin's F-16 and F-22 fighters.[17]

Congressional Perspectives. Individual Members of Congress and congressional committees have expressed both support for the JSF winner-take-all strategy, and concern over this approach. The Senate Appropriations Committee, in its report (S.Rept. 106-298 of May 18, 2000) on the FY2001 defense appropriations bill (S.2593), stated:

> The Committee is aware of no justification for changing the JSF acquisition strategy. The Committee directs that DoD use the available funds only to proceed with the original acquisition strategy of selecting a single design, and associated

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[13]David Fulghum, "Boeing Rejects Plan for Two JSF Lines," *Aviation Week & Space Technology*, April 24, 2000, p. 61.

[14]P.J. Skibitski, "Lockheed, Boeing Offer Divergent Opinions on JSF Production Options," *Inside the Air Force*, July 28, 2000.

[15]*Ibid.*

[16]Vago Muradian, "Aldridge: JSF Winner Free to Embrace Loser, Decision and Terms up to Victor," *Defense Daily*, September 20, 2001, p. 8.

[17]Greg Schneider, "Northrop Presses Pentagon on Fighter," *Washington Post*, March 21, 2000. p. E1.

> industry team, to develop the Joint Strike Fighter. The Committee believes that industrial base concerns can best be addressed after the source selection decision. Companies need to evaluate their desire to participate in the JSF program based on their strategic business objectives. While the future aircraft industrial base may be a concern, DoD can be partner in discussion to address these concerns as companies work on viable teaming or work sharing agreements.

Appropriations conferees also endorsed the winner-take-all strategy in their FY2001 report, (H.R. 4576, H.Rept. 106-754. p. 220) writing that "... industrial base concerns can best be addressed after the source selection decision."

Responding to a June 23, 2000 letter from then Secretary of Defense William Cohen which reaffirmed DoD's winner-take-all strategy, Rep. Jerry Lewis was quoted as saying "I am a very strong believer in the marketplace, and so I welcome this announcement." Senator Kay Bailey Hutchison reportedly also stated: "I think it was the right decision (sticking with winner-take-all) because it was the way it was originally proposed and how the companies proceeded and made their investment decisions. It is right to continue along the lines of the original expectations."[18]

However, congressional authorizors have been less supportive of the winner take all strategy. In their FY2001 reports, both the House Armed Services Committee (H.R. 4205 (H.Rept. 106-616) Subtitle E—Joint Programs, Section 141, p. 157), and Authorization Conferees (H.R. 5408, H.Rept.106-945) Subtitle E—Joint Programs Section 141, p. 37) directed DoD to submit a report to Congress on production alternatives for the Joint Strike Fighter aircraft program, and the effects on the tactical fighter aircraft industrial base of each alternative considered.

Senator Bob Smith, a member of the Senate Armed Services Committee, remarked that the winner-take-all strategy may be outdated given the current status of the defense industrial base. Senator Smith was reported to have commented that "awarding a major contract to one contractor 'was something we did 10 years ago...I don't know why we are still doing that.'"[19] Senator Christopher Bond is another opponent of the winner-take-all strategy. Senator Bond sponsored amendment 2553 to the FY2002 Defense Appropriations Bill (H.R. 3338), which directs DoD to conduct a six month study of the "current and future adequacy of the military aircraft industrial base."[20] This study is to be

> a comprehensive analysis of and report on the risks to innovation and cost of limited or no competition in contracting for military aircraft and related weapon systems for the Department of Defense, including the cost of contracting where there is no more than one primary manufacturer with the capacity to bid for and build military aircraft and related weapon systems, the impact of any limited competition in primary contracting on innovation in the design, development, and

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[18]Maria Recio and Dan Piller, "JSF Contract May Be Winner-Take-All After All," *Fort Worth Star Telegram*, June 23, 2001, p. 1.

[19] Kerry Gildea, "JSF Work Share Still Possible After Initial Contract Award, Warner Says," *Defense Daily*, October 24, 2001.

[20]*Congressional Record*, December 7, 2001, p. S12651 [daily edition].

> construction of military aircraft and related weapon systems, the impact of limited competition in primary contracting on the current and future capacity of manufacturers to design, engineer and build military aircraft and weapon systems.[21]

Part of the motivation behind this study is the belief that previous studies of the winner-take-all strategy have focused on the cost issues and not adequately considered industrial base concerns.[22]

Questions for Congress

When considering industrial base concerns, such as the potential national security implications of a single manufacturer of the JSF, the following questions arise: 1) Will awarding production of the JSF to a "single manufacturer" degrade the ability of the U.S. industrial base to generate competition in the design of short range manned combat aircraft in the post JSF time frame? 2) Will there be a demand for short range manned combat aircraft in the post-JSF environment?

Potential for Future Competition

It is important to keep in mind that design, production, and later modification and sustainment of existing aircraft are three separate and distinct functions.. Each of these functions demands a different set of specialized skills from the company that provides them.

Production, modification, and sustainment (in the form of ongoing maintenance) can continue for decades after a design is created (the Lockheed F-16 *Fighting Falcon* has been in production since the late 1970s, and the last Boeing B-52 *Stratofortress* entered service in 1962). Overseas customers sometimes continue to purchase new aircraft after production for U.S. military services have ceased taking delivery, and competition between the aircraft producers of various nations for sales to a particular air force is not uncommon.[23] Most observers agree that production, modification, and sustainment skills are transferrable between military projects and in many cases even between military and civilian aircraft programs.

The most strident JSF debate among industrial base analysts centers on the nurturing of innovative concept design. Some maintain that the basic design skills

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[21] *Ibid.*

[22] Frank Wolfe, "Bond Amendment Tasks DoD to Assess Risks of One Military Aircraft Maker," Defense Daily, December 11, 2001.

[23] See Doug Struck, "Seoul Signals It Will Buy Boeing Fighter Jets," *Washington Post*, March 28, 2002, p. A25. On March 27, the government of the Republic of Korea announced that it would purchase 40 F-15K fighters from Boeing between 2002 and 2008. Also competing for the contract were fighter makers Dassault Aviation (France, offering its *Rafale*), Sukhoi (Russia, with the Su-35), and Eurofighter (a European consortium, nominating the *Typhoon*).

necessary for short range manned combat aircraft are specific to that type and are inapplicable elsewhere. Others, however, believe that the ability to design aircraft is more general in character, and that the various aspects of design necessary to create a platform such as the JSF (maneuverability, stealth, habitability and safety of flight, propulsion, work with high-temperature metals and the like) are present in separate ongoing projects and can be brought together when needed.

Several studies have indicated that the aircraft design function requires constant exercise to maintain effectiveness.[24] As stated in a recent RAND report, "Experience matters. Prime contractors tend to specialize and develop system-specific expertise ... [A] strong experience base in specific types of military aircraft R&D or in specific technology areas appears to have been extremely important."[25] Nevertheless, it may be possible to keep engineering design teams together either in reality, working on advanced technology design and prototyping programs not intended to produce operational combat aircraft, or in virtual space, through the imaginative use of cutting-edge telecommunications and computer-design technologies. As one report phrased it, "[a]n aircraft design team, no matter how qualified and well supported, will inevitably lose its overall ability to produce new aircraft designs that incorporate advanced technologies if it goes too long without actually designing, flying, and testing new aircraft."[26]

It may be prudent to consider whether national security might benefit from encouragement of continued aircraft design activity. According to Department of Defense statements, the award of the JSF development contract marks the end of the design of short range manned combat aircraft for at least the next several decades. This has generated concern among industry observers over the retention of a viable U.S. design capability. John Douglass, president of the Aerospace Industries Association, has stated that "there's only so much more engineering work to be done once you've got the airplanes designed. ... If you don't design airplanes, you lose the capability to design them. Those engineers aren't going to sit around. The company's not going to pay them for 15 years to do nothing."[27]

On the other hand, the Department of Defense has pressed since the early 1990s for the integration, to the extent possible, of the U.S. commercial and defense industrial bases. The aim has been to spread the defense customer and the supplier base into the broader commercial economy, tapping into innovation not traditionally oriented toward defense. This could expand the pool of engineering talent available to design military aircraft while potentially increasing the number of active projects. In his 1995 annual report to the Congress, Secretary of Defense William J. Perry outlined a plan to "break down the barriers between the commercial and defense

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[24]See Drezner (1992); and Eugene Gholz and Harvey M. Sapolsky, "Restructuring the U.S. Defense Industry," *International Security* 24/3 (Winter) 1999/2000, pp. 5-51.

[25]See Mark A. Lorell and Hugh P. Levaux, *The Cutting Edge: A Half-Century of U.S. Fighter Aircraft R&D*, RAND: Santa Monica (CA), 1998.

[26]Drezner (1992), p. vii.

[27]Quoted in John M. Donnelly, "Aerospace Boss: Will Disaster Follow JSF?" *Defense Week*, October 16, 2000, p. 1.

industries" and to "realize the benefits of civil-military integration in both research and development (R&D) and manufacturing."[28] By 1999, he was reporting to Congress on his efforts to eliminate Defense requirements for separate military production lines of virtually identical products, again with an intention of eliminating the distinction between the defense and commercial industrial bases.[29] To the extent that the production of civil and military aircraft can be combined, it may be possible to employ engineering and technical teams in the manufacturing of both.

Much of the debate of the implications to the defense industrial base of the "winner-take-all" contract award focuses on the two contending prime contractors, Lockheed Martin and Boeing. However, the contest was actually between two competing international teams of companies led by the primes. Every portion of the two basic prototypes (the X-32 and the X-35) was designed and manufactured by one firm within a group, and several firms provided subsystems for both aircraft. The essential decision, then, was the selection of the overall system integrator and aircraft final assembler. This role of systems integrator and broad program director requires highly sophisticated management expertise and is increasingly the ability that defines the defense prime contractor and separates it from other defense firms.

This characteristic of the prime contractor to form subcontractors into competitive teams may have implications for the future of manned combat aircraft design competition. If the loss of the JSF program meant that Boeing could not compete for a similar future contract, it may be possible for another member of the Lockheed Martin team to do so. An example could be Northrop Grumman, which will provide aircraft structures, radar, and part of the electro-optical targeting system to the F-35. The company has extensive system integration expertise, has in the past created the F-5 *Tiger*, the F-14 *Tomcat*, and the B-2 *Spirit*, and is currently one of the leading companies developing an unmanned combat aerial vehicle (UCAV). Another company with a history in aviation and extensive system integration abilities is General Dynamics. After having sold its military aircraft division to Lockheed Martin in 1993, General Dynamics acquired Gulfstream Aerospace Corp., maker of the Gulfstream series of corporate jet aircraft, in 1999, and has since successfully marketed the aircraft as a special missions platform (signals intelligence, reconnaissance, atmospheric research, astronaut training, and medevac).

Another approach to aircraft development that has focused on the retention and employment of skilled design teams is the use of Advanced Concept or Advanced Technology Demonstrations. These projects concentrate on the concept development, design, prototype construction, and testing of cutting-edge or futuristic vehicle or system designs. Instead of being created to enter production, these prototypes are intended to demonstrate features that may be incorporated into existing vehicles or to expand the boundaries of achieved performance.

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[28]See "Economic Security – New Ways of Doing Business at Defense," in the *Annual Report of the Secretary of Defense to the Congress*, 1995.

[29]See "Chapter 15, Acquisition," in the *Annual Report of the Secretary of Defense to the Congress*, 1999.

In sum, some analysts hold that the award of the JSF production contract to a "single manufacturer" could adversely affect industry's ability to continue creating designs for short range manned combat aircraft if the arrangement causes the atrophy of expert design and production skills within the aerospace industry. However, others argue that any of several actions could mitigate this effect, including (but not limited to): the effective consolidation of commercial and defense design and production work, the creation of a series of advanced technology prototype demonstration projects, and potential reconsideration of the JSF as the last manned aircraft program of its type.

Potential for Future Demand. This question is important because, if there is a high demand for these kinds of aircraft in the 2020-2025 time frame, then it may be prudent to take steps today, to ensure a robust manufacturing capability – potentially safeguarding at least two JSF design teams and production lines – in the future. On the other hand, if there is no demand for such aircraft, of if the future demand is very small, then there may be no negative long term effects on the industrial base resulting from limiting JSF production to a single manufacturer. In fact, some argue that if manned combat aircraft are only a small part of tomorrow's air forces, then reducing the number of defense aerospace companies today that design and manufacture manned combat aircraft could be beneficial in the long run, by encouraging these companies to begin pursuing new designs, technologies, and markets.

Arguments for Limited Future Demand. Those who argue that there will be no or little demand for manned "tactical" combat aircraft in the 2020-2025 time frame typically point to the growing application of unmanned aerial vehicles (UAVs) and unmanned combat aerial vehicles (UCAVs)[30], the perceived imbalance in force structure between short range and long range combat aircraft, and the increasing need to be able to engage in combat in distant theaters that may lack robust infrastructure.

Proponents argue that UAVs and UCAVs are already playing a prominent role in warfare, and that the technological, doctrinal and political barriers to increased applications of UAVs are rapidly disappearing. The emergence of UAVs can be seen in several areas. First, leaders in both the executive and legislative branches recognize the importance of UAVs and have taken steps to encourage their accelerated development and fielding. In its FY2001 Defense Authorization Report (S.2549, 106-292, Section 217, p. 141), Senate authorizors strongly endorsed the pursuit of unmanned air and ground vehicles. They authorized an increase of $200 million in unmanned systems RDT&E, and challenged DoD with this goal: "within 10 years one-third of U.S. military operational deep strike aircraft will be unmanned and within 15 years one-third of all U.S. military ground combat vehicles will also be unmanned."

In his December 11, 2001, speech on military transformation, President Bush strongly voiced his support for UAVs. "Now, it is clear the military does not have enough unmanned vehicles. We're entering an era in which unmanned vehicles of all kinds will take on greater importance – in space, on land, in the air, and at sea." he

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[30]For more information on UCAVs, see CRS report RL31014, *Unmanned Combat Air Vehicles: Issues and Outlook*, by Robert E. Chapman, II.

said.[31] Furthermore, proponents note, in the entire speech, President Bush mentioned only two weapon systems specifically by name: the Predator, and Global Hawk UAVs. Proponents argue that leadership at high levels is a necessary component of military transformation, and UAVs and UCAVs have such backing.

The recent successful operational employment of UAVs is the second area which proponents cite as evidence of the likelihood of UAV and UCAV future growth. Before Operation Enduring Freedom, proponents point out that the Predator UAV already had a successful operational track record in Bosnia, Albania, and over Iraq. In Afghanistan, however, the Predator systems made important leaps in military capability by successfully employing Hellfire missiles, and by passing real time, fire control quality targeting data to AC-130 gunships. Both capabilities are much needed advances, proponents argue, against some of the most challenging tasks facing the military, such as destroying time critical targets. Proponents also argue that the Global Hawk UAV is making an important contribution to Operation Enduring Freedom, despite still being in its experimental phase. In fact, Global Hawk's experience in Afghanistan is very similar to that of the then-experimental JSTARS program in Operation Desert Storm (the 1991 war with Iraq). Following the JSTARS successful employment in Iraq, this program was accelerated and now plays a prominent role in the U.S. airborne reconnaissance force structure. Proponents suggest that Global Hawk will likely follow a similar path.

Another factor that proponents argue points to the inexorable growth of UAVs is that UAV programs are being accelerated in the current Future Year Defense Plan (FYDP). The Air Force, for example, recently completed a development roadmap for the Global Hawk, which not only boosts production of the aircraft, but also more aggressively pursues power and payload improvements that would make it more able to replace the U-2 reconnaissance aircraft.[32] Also, the Pentagon's comptroller is urging the Air Force to purchase 15 additional Predator UAVs in its FY2003 budget request. This proposed acceleration is on top of the President's allocation of $21 million from the $40 billion counter terrorism supplemental toward the purchase of new Predators.[33]

Others argue that the demand for new manned "tactical" combat aircraft in the 2020-2025 time frame will be very small compared to today's demand because DoD must aggressively pursue long range combat aircraft, or bombers. In fact, many argue that if DoD is serious about transforming itself, it must cut or cancel the JSF program and build long range bombers instead.[34] A "Transformation Panel" chaired by retired Air Force General James McCarthy, reported in the summer of 2001 that long-range

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[31]Remarks by the President at the Citadel. Charleston, South Carolina, December 11, 2001, 1:54P.M. EST.

[32]Amy Butler, "USAF Settles on Global Hawk Transformation, but Funding Unsure," *Defense Information and Electronics Report*, December 14, 2001.

[33]Amy Butler, "Pentagon Comptroller Suggests Funds for 15 Additional Predators," *Defense Information and Electronics Report*. December 14, 2001.

[34]Jonathan Block, "CSBA Says DoD Should Cancel JSF, Buy 20 More B-2s Over 10 Years," *Inside the Air Force*, June 22, 2001.

precision attack was one of the six capabilities necessary to quickly gain the upper hand in future crises.[35] Transformation advocates claim that because they can't match U.S. air power capabilities, tomorrow's foes will stress anti-access capabilities (such as surface to air missiles), which are arguably more threatening to low flying tactical combat aircraft than they are to high flying bombers. Also, the United States must be prepared to fight conflicts in distant theaters with poor infrastructure. Long range can help ameliorate this challenge by reducing the requirement for bases near the battlefield. This also reduces the strain put on airlift and aerial refueling assets.

Advocates of greatly increasing the ratio of long range bombers to short range tactical combat aircraft say that DoD concepts and doctrine make their case for them. They point out that the 2001 Quadrennial Defense Review (QDR), for example, emphasizes the need for long range precision strike capabilities. In setting the ground rules and definitions for the QDR Secretary of Defense Rumsfeld named 13 investment priorities to be studied. Prominent among them was precision strike.[36] The published QDR document discusses the need for long range precision strike 10 times in 79 pages.

In the Spring of 2001, the Air Force's Air Combat Command (ACC) unveiled its new "Global Strike Task Force Concept," a refinement of "Global Reconnaissance Strike," a warfighting concept introduced the year before. Prominent in both concepts is a strong role for long range bombers in future expeditionary operations.[37] Gen. Richard Hawley, retired former commander of ACC and principal author of the initial Global Reconnaissance Strike paper, emphasized the importance of long rang attack aircraft: "A bomber centric approach can deny an enemy his anti-access objectives, attack his key strategic infrastructure, slow or halt his forces, and beat down his defenses while the other elements of the joint force are safely built up in theater."[38]

Those who advocate an increased emphasis on long range bombers say that recent conflicts show how important bombers are to air operations. In Operation Allied Force, the 1999 war in Kosovo, heavy bombers accounted for less than 5 percent of the aircraft involved, but released 53 percent of the bombs and missiles.[39] Operation Enduring Freedom, the current war against terrorism in Afghanistan further illustrates the importance of bombers, advocates say. Air Force bombers accounted for about 20 percent of combat missions and dropped more than 76 percent of the bomb tonnage in the first three weeks of the air campaign.[40] In contrast, Air Force

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[35] John Tirpak. "Bomber Questions," *Air Force Magazine*, September 2001.

[36] *Ibid*.

[37] David Fulghum, "USAF Plans Rapid, All-Stealth Task Force," *Aviation Week & Space Technology*, February 26, 2001.p. 24; and Amy Butler, "ACC Chief to Unveil 'Global Strike Task Force' Concept Next Week." *Inside the Air Force*, February 9, 2001.

[38] John Tirpak, "Bomber Questions," *Air Force Magazine*, September 2001.

[39] Bruce Rolfson, "Bombers Shine in Air War but Remain Budget Targets," *Air Force Times*, November 26, 2001.

[40] *Ibid*.

fighters have played a small role in the air strikes. Except for a handful of F-15Es, Air Force fighters sat out the first month of the Afghanistan air war.

Bomber advocates also say that recent technological advances have greatly improved bombing accuracy and flexibility, two areas where in the past, tactical combat aircraft may have had superior capabilities. Long range bombers in Operation Enduring Freedom are dropping the same GPS-guided munitions as dropped by tactical combat aircraft. And, advances in information and communications technologies allow today's bombers to change target sets in mid-flight. These improvements are opening up new applications for long range bombers, such as conducting close air support missions, and pursuing time critical targets such as mobile Scud missiles. The performance of long range bombers in Afghanistan has prompted important decision makers to question the Air Force's proposed plan to retire 33 B-1B bombers at the end of FY2002. Sen. John Warner, for example was reported to have said that this retirement needs to be re-evaluated in light of events in Afghanistan.[41]

Despite the real advantages that bombers confer on U.S. military operations, the current aircraft force structure is weighted heavily toward short range combat aircraft, and away from long range bombers, say bomber advocates. Today, the ratio of short range combat aircraft to long range bombers is approximately 16 to one, meaning less than six percent of the service's 4,000 aircraft are heavy bombers. In contrast, the ratio of fighters to bombers was two to one in 1950.[42] Bomber advocates say that this imbalance will grow, as the ratio of dollars spent on fighters to bombers will go from less than five to one in 1999 to more than 30 to one in 2003.[43] Furthermore, advocates say, this imbalance in expenditures needs to be redressed because bombers are more cost effective than tactical combat aircraft. Gen. Richard Hawley, retired former head of the USAF Air Combat Command, for instance, argues that "Bombers require fewer pilots and less investment than fighters to deliver the same number of munitions..."[44]

A final argument for why the future demand for manned tactical combat aircraft will likely be very small rests at the intersection of the two previous arguments – the growth of UAVs and bombers. Specifically, unmanned long range bombers may be feasible in the 2020 time frame. Boeing, for example, has recently marketed DoD on an unmanned bomber concept based on its UCAV-N concept. This stealthy long range UCAV would carry 50-75,000lbs of ordnance internally.[45]

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[41]Jonathan Block, "Warner Signals B-1 Retirement Plan May Need Reconsideration," *Inside the Air Force*, December 4, 2001.

[42]Laura Colarusso, "Analysts: USAF Bomber Force Dangerously Close to Serious Disconnect," *Inside the Air Force*, October 19, 2001.

[43]*Ibid.*

[44]John Tirpak, "Bomber Questions," *Air Force Magazine*, September 2001.

[45]Robert Wall, "USAF Bomber Plans Spark Renewed Debate," *Aviation Week & Space Technology*, April 10, 2000, p. 30.

Arguments for Significant Future Demand. Others argue, however, that the post-JSF demand for short range, manned combat aircraft will likely be significant. Tactical combat aircraft advocates say that predicting the future is extremely difficult, and that it is premature to plan for the end of manned tactical combat aircraft. Long range ballistic missiles – which have been used in warfare since 1945 – still have not replaced long range bombers. Satellites, which were first launched in the late 1950s still have not replaced manned surveillance aircraft. Similarly, UAVs have been around since the early 1910s, say opponents, yet they have only recently become operationally effective.[46] It is not likely that they will replace manned aircraft in the near future. Instead, much like satellites and ballistic missiles, UAVs will likely complement manned combat aircraft.

While it is true that today's UAVs such as Predator and Global Hawk are useful, their reported effectiveness in Afghanistan needs to be balanced with their documented problems, to get a clear picture of future developmental challenges. For example, a recent report by DoD's director of Operational Test and Evaluation criticized the Predator, saying that a number of faults "renders the Predator not operationally effective in meeting the mission requirements" delineated in its Operational Requirements Document.[47] Two Global Hawk UAVs have crashed in development, due to problems in remote piloting of the aircraft.[48] A third Global Hawk crashed during Operation Enduring Freedom. The Pentagon says that the crash was not due to enemy fire, but the exact cause of the accident remains unclear.[49] In addition to these reliability problems, opponents say that UAVs are more vulnerable to enemy action than are manned aircraft. While many are likely shot down because they operate in areas too dangerous for manned aircraft, they are also less survivable, opponents say, because they are less responsive to threats. A pilot has better situational awareness than a remotely located UAV operator, and he/she can take more immediate and decisive evasive action if required. UAV opponents pont out that approximately 20 Predator UAVs have been lost to accident and enemy action, while the United States lost only two manned aircraft in Kosovo, and none thus far in Afghanistan.

Manned combat aircraft proponents also say that there are many combat missions that will remain beyond UAVs' capabilities. Air-to-air combat, for example, requires a level of situational awareness, responsiveness, and adaptability that requires a human in the cockpit, say tactical combat aircraft advocates.

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[46] In 1916, a UAV prototype called the Hewitt-Sperry Automatic Airplane made a number of short test flights. Most UAV programs were cancelled at the end of World War I in 1918.

[47]Thomas P. Christie, director, *Operational Test and Evaluation Report on the Predator Medium-Altitude Endurance Unmanned Aerial Vehicles* (Executive Summary), Washington: Department of Defense Office of Operational Test and Evaluation, September 2001.

[48]Mark Thompson, "Crashing From the Air – And on the Ground," *Time*, May 8, 2000, p. 26; and Amy Butler, "Global Hawk's Flight Status Reinstated: Improper Mission Computer Input said to be Key Factor in UAV Crash," *Inside the Air Force*, March 17, 2000.

[49]Paul Richter, "Global Hawk Crashes in Afghanistan In a Set-Back for High Tech Drones," *Los Angeles Times*, January 1, 2002. p. 3.

Even if UAV technology continues to advance, opponents say, there are organizational and cultural factors that could impede their increased application. Some argue that the civilian leadership of DoD is much more bullish on UAVs than are the military services. Officials in the Office of the Secretary of Defense, for example have said that the Air Force and Navy have emphasized investments in manned strike platforms, to the detriment of UAV programs.[50] Culturally, UAV opponents argue, very few people join the Air Force to sit in a mission control center and stare at a computer screen. People join the Air Force because they want to fly airplanes, and the types of airplanes they most want to fly are tactical combat airplanes. Moving to a UAV-centric force could seriously damage recruitment efforts, say manned aircraft proponents.

Advocates of tactical manned combat aircraft also say that while anti-access challenges are real, increased emphasis on long-range bombers is not necessarily the best solution. One real challenge for long range bombers is sortie generation rate. Flying long distances to attack targets takes time, wears out crews and generally makes it difficult or impossible aircraft to fly multiple, daily sorties. The B-2, while touted for its ability to strike targets in Afghanistan all the way from its base in Missouri, has not flown in Operation Enduring Freedom since the first days of the war. Instead, B-1s and B-52s have been forward deployed. Advocates say that tactical combat aircraft based in-theater are better at keeping pressure on the enemy through numerous and continuous attacks.

If the theater lacks bases, the U.S. can bring bases to the theater. Afghanistan has called attention to the utility of carrier-based aviation. Also, DoD is exploring mobile off shore logistics bases (MOLBs), which could serve as "super aircraft carriers" for Air Force fighters. Carrier-based aircraft, coupled with vertical/short take off and landing aircraft (VSTOL) – which can effectively operate from short or austere runways—and potentially Air Force fighters operating from MOLBs may be a better approach than relying on long range bombers.

A final point that advocates make in support of the fielding of manned tactical combat aircraft, is that the overall military aviation piece of DoD's budget is likely to increase in the future. They argue that recent conflicts (Iraq, Bosnia, Kosovo, Afghanistan) illustrate that air power is playing a key role in U.S. military operations, and is therefore worthy of a larger part of the budget relative to other elements of the force structure. Even if UAVs and long range bombers were to become more prominent in the U.S. military force structure, advocates say, this doesn't necessarily have to come at the expense of tactical manned combat aircraft. Proponents argue that the funding for more bombers and UAVs is more likely to come from other areas (e.g. reductions in ground forces, or from savings from base closure and realignment), rather than from decrements in the manned tactical aviation budget.

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[50]Marc Strass, "DoD Official Questions Services' Commitment to UAVs," *Defense Daily*, December 14, 2001.

Appendix: Defense Industrial Base Issues[51]

Consolidation. The U.S. defense industry was born in the expansion of war industries that began in 1940 and carried the United States and its allies through World War II. Much of this production capacity turned to the creation of commercial manufacturing in the late 1940s, but the beginning of the Cold War and the outbreak of war in Korea caused the Government to return defense production to a war footing, particularly in the electronics and aerospace sectors. Although appropriations for defense procurement have fluctuated in the decades since, the close relationship between some major aerospace and electronics corporations and the Department of Defense forged during the Korean War and the Cold War remain strong.

Deep cuts in defense funding, comparable to those experienced at the end of the Vietnam War, followed the rapid expansion of the 1980s. **Table 1** illustrates the peaks and troughs in defense outlays (the funds actually paid out to industry) for procurement since World War II..

Table 1: Procurement Outlays
Peaks and Troughs: FY2003 Dollars (thousands)

		Fiscal Year	Amount	Change Percent Change
World War II	Hi	1945*	$405,240	-$389,844
	Lo	1948	$15,396	-96.2%
Korea	Hi	1953	$116,228	-$44,124
	Lo	1956	$72,104	-38.0%
Vietnam	Hi	1969	$115,255	-$64,765
	Lo	1976	$50,490	-56.2%
Cold War	Hi	1987	$115,616	-$64,135
	Lo	1997	$51,481	-55.5%

*: Figures for 1941-1944 unavailable.
Source: Office of the Undersecretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2003*. (available http://www.dtic.mil/comptroller/fy2003budget)

The end of the Cold War and the collapse of the Soviet Union the following year ended any expectation of a near-term upturn, and many analysts concluded that the Department of Defense could not continue to support a Cold War-sized industrial structure. In early 1993, Under Secretary of Defense William Perry told a gathering of senior defense industry executives that DoD would no longer oppose corporate mergers and acquisitions that made commercial sense. In July, 1993, John Deutch,

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[51] For a more comprehensive treatment, see CRS Report RL30720, *The U.S. Defense Industrial Base: Trends and Current Issues*, by Daniel H. Else.

Perry's under secretary for technology and acquisition, issued a policy permitting reimbursement of merger costs in cases where the consolidating companies could show that the action would result in savings to the Government. There followed a wave of corporate buyouts as many of the major defense contractors joined with or purchased parts of each other. **Table 2** gives some partial examples of consolidation activity that occurred between 1993 and 2000.

Table 2: Consolidation of U.S. Defense Firms, 1993-2000

Corporation/Division (1993)	Corporation (2000)
Boeing McDonnell Douglas Rockwell	Boeing
Litton Industries Avondale Industries	Litton Industries
Lockheed Martin Marietta Loral Ford Aerospace General Dynamics (Fort Worth Division)	Lockheed Martin
Northrop Grumman LTV (Aircraft) Westinghouse (Electronic Defense) General Dynamics (Space)	Northrop Grumman
Raytheon General Dynamics (Missiles) Hughes Electronics Texas Instruments (Electronics)	Raytheon

Source: *Aviation Week and Space Technology*, May 8, 2000, p. 23

Despite consolidation at the corporate level, production capacity among the major contractors appears to have remained stable and more than adequate to satisfy service needs. In a 1999 study, Eugene Gholz and Harvey M. Sapolsky noted that no major production lines were closed during the 1990s phase of consolidation.[52] The nature of modern warfare (short conflicts characterized by high rates of munition expenditure and low rates of equipment loss versus the World War II model of long conflict and the loss of large stocks of military equipment) makes it unlikely, in the view of most defense analysts, that there will be a need for large scale mass manufacturing industrial mobilization. Rather, analysts expect critical defense production bottlenecks to appear during weapon replenishment surges in stocks of sophisticated weapon subcomponents manufactured by second- or third-tier subcontractors.[53]

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[52]Eugene Gholz and Harvey M. Sapolsky, "Restructuring the U.S. Defense Industry," *International Security* 24/3 (Winter) 1999/2000, pp. 5-51.

[53]See Jason Sherman and Amy Svitak, "Arms Replenishment Adequate Despite Mergers," (continued...)

Competition. Some analysts hold that competition for production contracts is a principal means of restraining in reducing the price of goods and spurring innovation. In defense procurement, acquisition decisions made by DoD strongly influence the number of prime contractors that remain active within a given product line and the level of competence they bring to bear on the design and manufacture of advanced weapon systems.[54] As the number of producers shrinks in a consolidating industry sector such as shipbuilding or aircraft manufacturing, there is an increasing tension between anticipated consolidation-related efficiencies (economies of scale and per unit cost reductions) and reduced competition (affecting both costs and the pace of innovation).

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[53](...continued)
Defense News, October 15-21, 2001, p. 8.

[54]See William E. Kovacic and Dennis E. Smallwood, "Competition Policy, Rivalries, and Defense Industry Consolidation," *Journal of Economic Perspectives* 8/4 (Fall) 1994, pp. 91-110.